HDR-L35028SC-CG5

DC-DC Converter **Data Sheet**

Features:

- Industry Standard 1/2 brick package & footprint
  2.4 " ×2.28 " ×0.5 "
- High Power density:128W/in^3
- High Efficiency: 89% typical
- 2:1 Wide Input Voltage Range
- Low Output Ripple & Noise
- Remote on/off and Remote Sense
- Thermal Protection: auto-recovery
- Output Over-voltage Protection: latched
- Adjustable Output Voltage: -40%～+10%Vo
- Output Over-voltage Protection
- Output Over-current Protection
- Operating Baseplate Temperature Range: -40℃～＋100℃
- EN60950-1:2006 Recognized
- RoHS (2002/95/EC) Complaint

Numbering Convention

HDR - L 350 28 S C - C G5
① ② ③ ④ ⑤⑥ ⑦ ⑧

No	Features	Descriptions
①	Product Series	HDR—Al-baseplate half brick series
②	Remote on/off Logic	L-Negative Logic
		H or default –Positive Logic
③	Rated Output Power	350- Max output power:350W
④	Rated Output Voltage	28-Rated output voltage: 28V
⑤	Number of Outputs	S- Single Output
		D- Dual Output
⑥	Rated Input Voltage	C-Rated Input Voltage: 48V
⑦	Sprayed Conformal Coating	C-Sprayed Conformal Coating
		Default-No Sprayed Conformal Coating
⑧	ROHS	G5-ROHS5
		G-ROHS6
		Default: lead products

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1. Description

The HDR-L35028SC-CG5 series power modules are DC-DC converters in an industry 1/2 brick package and footprint, and can provide up to 28V_{DC} output voltage and 12.5A output current. The modules are packed in a molded package with Aluminum baseplate. The power modules feature wide input voltage range, high efficiency, excellent thermal performance and high input-output isolation voltage, and are well suited for telecommunication, industrial automation and test equipment.

2. Technical Specifications (Unless otherwise stated, all specifications are typical at nominal input voltage, full load, 25 ℃ and with heat-sink)

Parameter		Test Condition	Min	Typ	Max	Unit
2.1 Absolute Maximum Ratings						
Input Voltage (Vi)		Non-operating, continuous	0	—	80	Vdc
		Transient (100ms)	—	—	100	Vdc
Max Output Power (Pomax)		allowable operating conditions	—	—	350	W
2.2 Input Specifications						
Norminal Input Voltage(Vinom)		—	—	48	—	Vdc
Input Voltage Range (Vin)		Ionom	36	—	75	Vdc
Input Under-voltage Protection Threshold		Ionom	28	—	33	Vdc
Input Under-voltage Recovery Threshold		Ionom	31	—	36	Vdc
Max Input Current (Iimax)		Vimin, Vonom,Ionom	—	—	11.0	A
Unload Input Current (Iio)		Vinom, Io＝0A	—	—	60	mA
Quiescent Input Current (Iiof)		Vinom, remote output shutdown	—	—	10	mA
Unload Power Loss		Vinom, Io=0A	—	—	2.9	W
Transient Current		Vimin, Vonom, Io=Ionom	—	—	1	A^2S
Input Reflected Rippled Current		Vinom,Ionom	—	100	200	mAp-p
Input Filtering Current		Vimin-Vimax	—	440	—	μF
Remot	Off	Low Level (≤0.4V, referenced to -Vin) or shorted to -Vin				
	On	High Level (2.4~48V or Open Circuits, referenced to -Vin)				
2.3 Output Specifications						
Nominal Output Voltage Set-point (Vonom)		Vinom,Ionom	27.72	28	28.28	Vdc
Nominal Output Current (Ionom)		—	—	12.5	—	A
Output Current Range (Io)		Po≤350W	0	—	12.5	A
Line Regulation (Vov)		Vimin-Vimax,Ionom	—	—	±0.5	%Vo
Load Regulation (Vol)		0-100%Ionom,Vinom	—	—	±1	%Vo

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Parameter		Test Condition	Min	Typ	Max	Unit
Voltage Stabilization Precision		V_{inmin}~V_{inmax},0~100%I_O	—	—	±1	%Vo
Output Voltage Trim Range (Voadj)		Io≤Ionom,Po≤350W	-40	—	+10	%Vo
Output Over-voltage Protection	Protection Mode	——	output voltage clamp			—
	Threshold	Po<Pomax	35.0		39.2	Vdc
Output Over-current Protection	Protection Mode	——	Hiccup, Auto-recovery			—
	Threshold	Vinom	105	—	140	%Ionom
Output Short-circuit Protection	Protection Mode	——	Hiccup, Auto-recovery			—
	Input Current	Vimin-Vimax,Ionom (Hiccup, Peak Value)	—	—	3.0	A
Load Dynamic Response	Peak Deviation	25%-50%-25%Ionom 50%-75%-50%Ionom Slope:1A/μS,Vinom	—	—	560	mV
	Settling Time		—	—	200	μs
	Peak Deviation	0%-100%-0%Ionom Slope:1A/μS,Vinom	—	—	14000	mV
	Settling Time		—	—	1000	μs
Output Ripple & Noise	Pk-to-Pk (20MHz)	Room Temp.: V_{inmin}~V_{inmax}, Ionom, add a 220μF(low ESR) electrolytic capacitor and a 0.1μF ceramic capacitor to output; add a 100μF/100V electrolytic capacitor to input	—	—	280	mV
	Pk-to-Pk (100MHz)		—	—	280	mV
	Pk-to-Pk (20MHz)	Low Temp.(-40℃): V_{inmin}~V_{inmax}, Ionom, add a 1000μF (low ESR) electrolytic capacitor and a 0.1μF ceramic capacitor to output	—	—	560	mV
	Pk-to-Pk (100MHz)		—	—	560	mV
External Output Capacitance (Co)		Vinmin~Vinmax, 0~100%I_O	220	—	4700	μF
Turn-on/off Overshoot Amplitude		Vinom,Ionom	—	—	±5	%Vo
Turn-on Delay Time		10%Vinom～90%Vonom	50	—	200	mS
Output Rise Time		10%Vonom～90%Vonom	10	—	100	mS
2.4 Safety Specifications						
Insulation Strength	Input to Output	Leak Current≤1mA, 1min	1500	—	—	Vdc
	Input to Al-baseplate	Leak Current≤1mA, 1min	1050	—	—	Vdc
	Output to Al-baseplate	Leak Current≤1mA, 1min	500	—	—	Vdc
Isolation Resistance (RISO)		500V_{DC}	50	—	—	MΩ
Safety Certification		EN60950－1:2006				
2.5 Reliability						
Vibration Test(sine)		Frequency: 10~55Hz Amplitude: 0.35mm Acceleration: 10m/s2 Cycle: 30min for each X,Y,Z axis	After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-p) meet the data sheet requirements.			

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Parameter		Test Condition	Min	Typ	Max	Unit
Impact Test (half-sine)		Peak Acceleration: 300m/s2 Duration: 6ms 6 times for three perpendicular directions	After being tested, no damage to the converter and its components, the appearance, output voltage and output ripple and noise (p-p) meet the data sheet requirements.			
MTBF		Vinom,Ionom, Ta=25°C Bellcore TR-332,	≥2×10^6			h
		Vinom,Ionom, Ta=70°C Bellcore TR-332	≥8×10^5			h
2.6 Environmental Specifications						
Relative Humidity		(40±2) ℃, Non-condensation	—	—	90	%RH
Cooling		——	Conduction Cooling (Force-air or heat sink)			
Over-temperature Protection	Protection Mode		Hiccup, Auto-recovery			
	Temp. Range	Baseplate temp.	100℃~125℃			
	hystersisMode	Baseplate temp.	5	10	15	℃
Operating Baseplate Temperature		——	-40	—	+100	℃
Storage Temperature (Tst)		——	-55	—	+125	℃
2.7 General Specifications						
Switching Frequency		——	—	280	—	kHz
Temperature Coefficient (Tcoeff)		——	—	—	±0.02	%/℃
Efficiency (η)		Vinom,Ionom	89	90	—	%
Weight		——	—	80	—	g
RoHS		RoHS(2002/95/EC)				
Anti-sulfuration feature		Sprayed conformal coating (with a suffix of “C” in model number)				

Note: when testing, external heat-sink and forced-air cooling are required.

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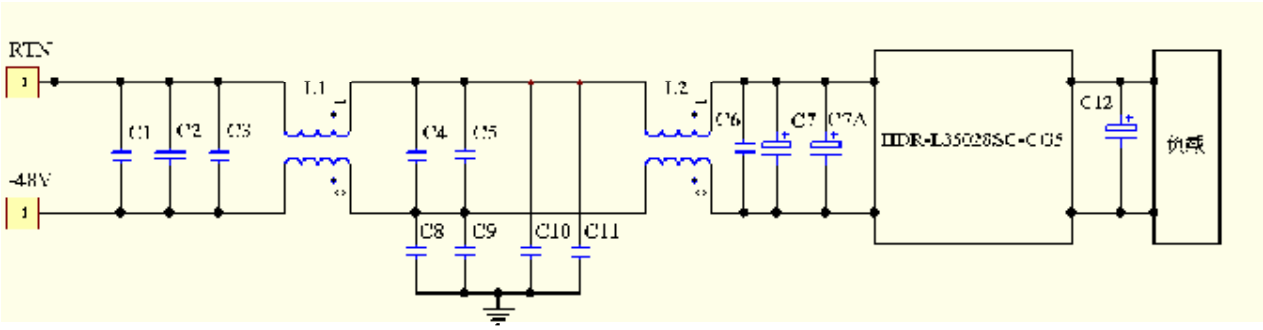
3. Basic Application Circuit and Considerations

3.1 Typical Application



Note:

C1, C2, C3, C4, C5: X7R-1000nF/100V ceramic capacitor; C6: X7R-100nF/100V ceramic capacitor; C8, C9, C10: X7R-100nF/1000V ceramic capacitor; C11: X7R-100nF/1000V ceramic capacitor; C7, C7A: 220μF/100V Low-ESR electrolytic capacitor; C12: ≥220uF/50V Low-ESR electrolytic capacitor; L1, L2: 473uH-14A Common-mode Inductor (Single phase)

3.2 Input Voltage up to 80Vdc for long time or reverse input polarity would cause the module damaged.

3.3 Output will be off when the Rem is at low level or connected to –Vin; Output will be on when the Rem is at high level or when the Rem keeps open circuit referenced to –Vin.

3.4 Output short-current protection mode is hiccup, automatic recovery.

3.5 Output Trim: Exceed the maximum output power (trim up) or the maximum output current (trim down) may cause the converter operates abnormally. The output voltage shall not exceed 52.8V (trim up) or be lower than 43.2V (trim down), or the converter can't work well.

3.6 With no output trim, connect +S and –S to $+V_O$ and $-V_O$ respectively; when testing, it is required to connect +S and –S to $+V_O$ and $-V_O$ respectively, or the module will be in over-voltage conditions.

3.7 when operating at high temperature, it is required to keep the air channel clean.

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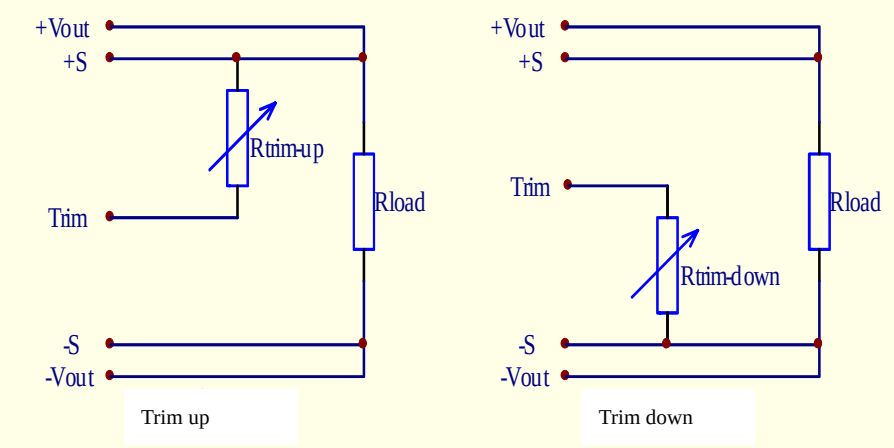
4 Instructions for Use and Test (heat-sink or forced-are cooling required)

4.1 Output Voltage Adjustment (trim)



4.2 Output Voltage Trim Equations

(1) Trim up:

$$R_{adj\_up} = \left(\frac{V_o(100\%+\Delta\%)}{1.225\times\Delta\%} - \frac{100\%+2\times\Delta\%}{\Delta\%}\right)k\,\Omega$$

(2) Trim down:

$$R_{adj\_down} = \left(\frac{100\%}{\Delta\%} - 2\right)k\,\Omega$$

Where V_O is nominal output voltage,

$R_{Trim-up}$、$R_{Trim-down}$ are external adjusting resistors, and

$\Delta(\%)$ is change of output voltage to nominal output voltage.

4.3 The over-voltage protection functions when the trimmed voltage exceeds the threshold.

4.4 Operating in over-current conditions for long time will cause the module damaged.

4.5 Over-temperature protection: when the temperature of baseplate is at 100℃~125℃, the over-temperature protection functions and the output is off; when the temperature is 10°C lower than the threshold, the module recovers automatically.

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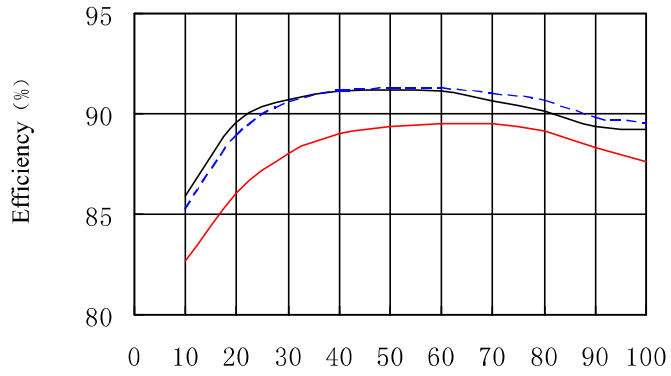
4.6 When using remote sense, use twisted-wire to connect +S and –S to +Load and –Load respectively; when using no remote sense, use twisted-wire to connect +S and –S to +Vo and –Vo respectively. The twisted-wire shall be as short and tight as possible.

4.7 In hipot test, short input +Vin, -Vin and Rem, short +Vout, -Vout, Trim, +S and -S.

4.8 Over-voltage protection: it is forbidden to directly short +S to TRIM to test the over-voltage protection.

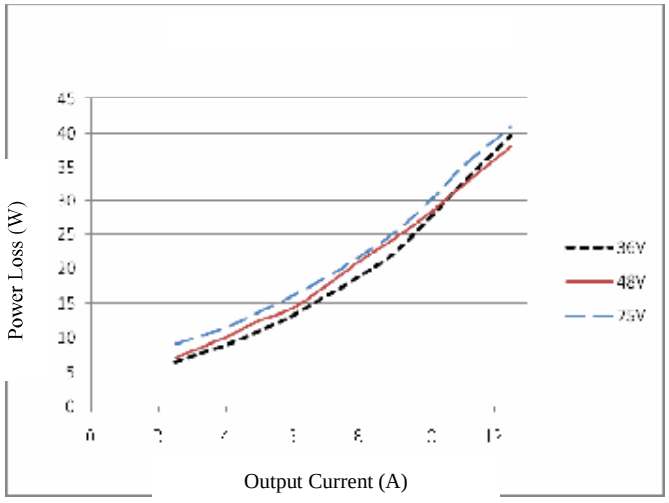
5 Characteristic Curves **(Ta=25℃)**

5.1 Efficiency Curve and Figure of Power Loss vs. Output Current



Load	20%Io	50%Io	80%Io
Efficiency (%) (Vin=48V)	88.9	91.25	90.6

Efficiency Curve



Power Loss vs. Output Current

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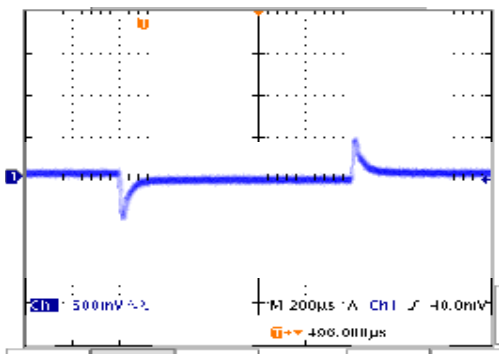
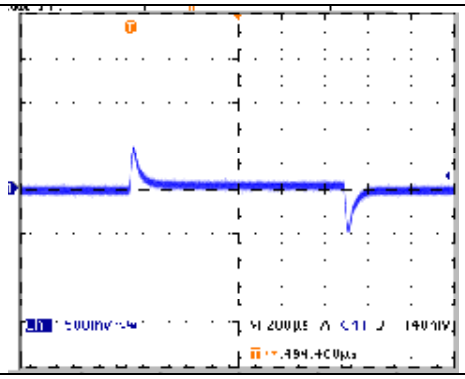
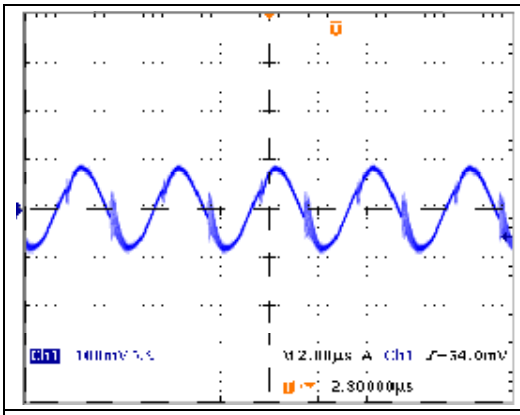
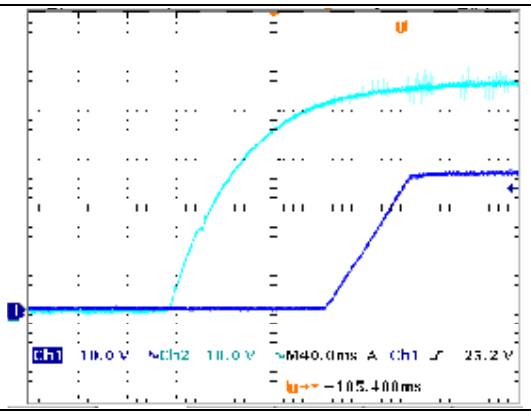
5.2 Dynamic Response

Test Conditions: Vin=48V, add a 0.1μFceramic capacitor and a 220μF electrolytic capacitor to output

	
25%-50%-25% Load	50%-75%-50% Load

5.3 Output Ripple and Turn-on Wave

Test Conditions: Ta=25℃,Vin=48V, Io=12.5A,20MHz, add a 220μF (Low-ESR) electrolytic capacitor and a 0.1μF high-frequency ceramic capacitor to output.

	
Output Ripple (Vin=48V,Io=12.5A)	Turn-on Wave (Vin=48V,Io=12.5A, CH1: output wave CH2: Input wave)

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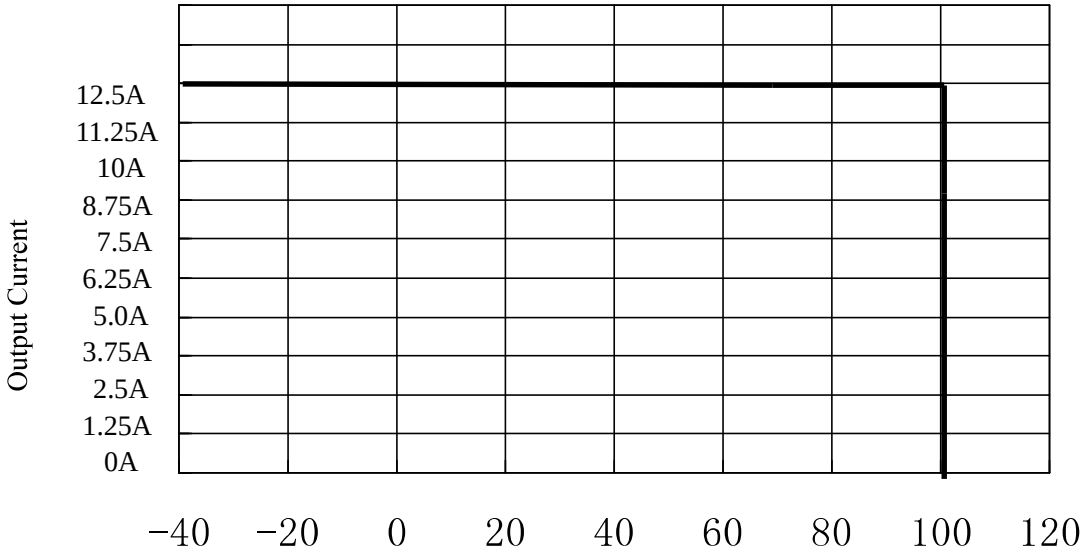
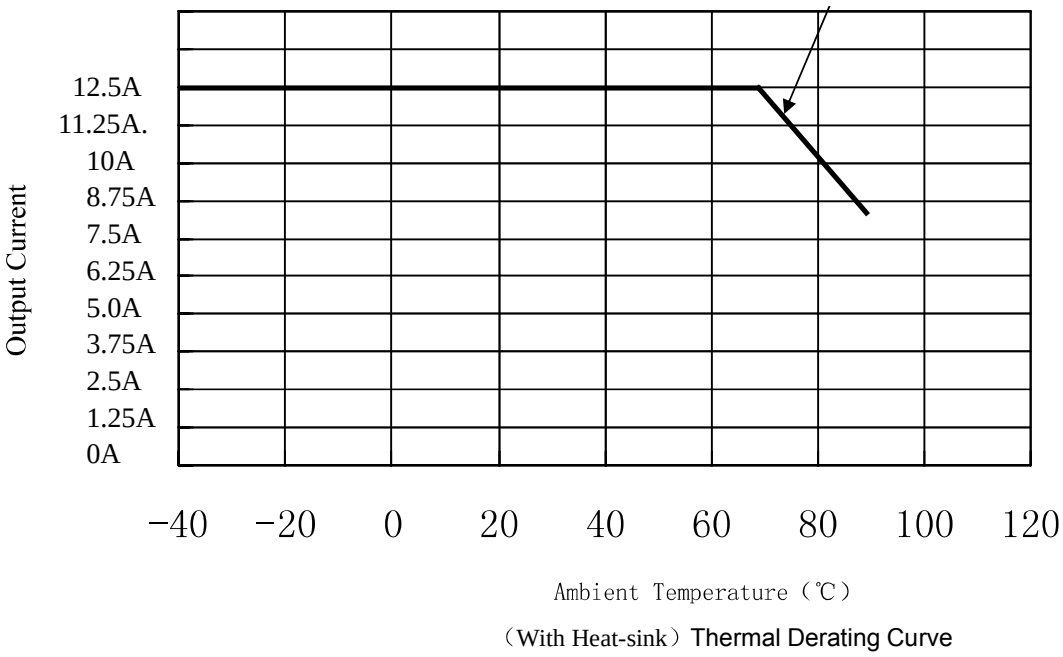
5.4 Thermal Derating Curve



(Case Temp.) Thermal Derating Curve

With Heat-sink（250×120×25mm）



（With Heat-sink）Thermal Derating Curve

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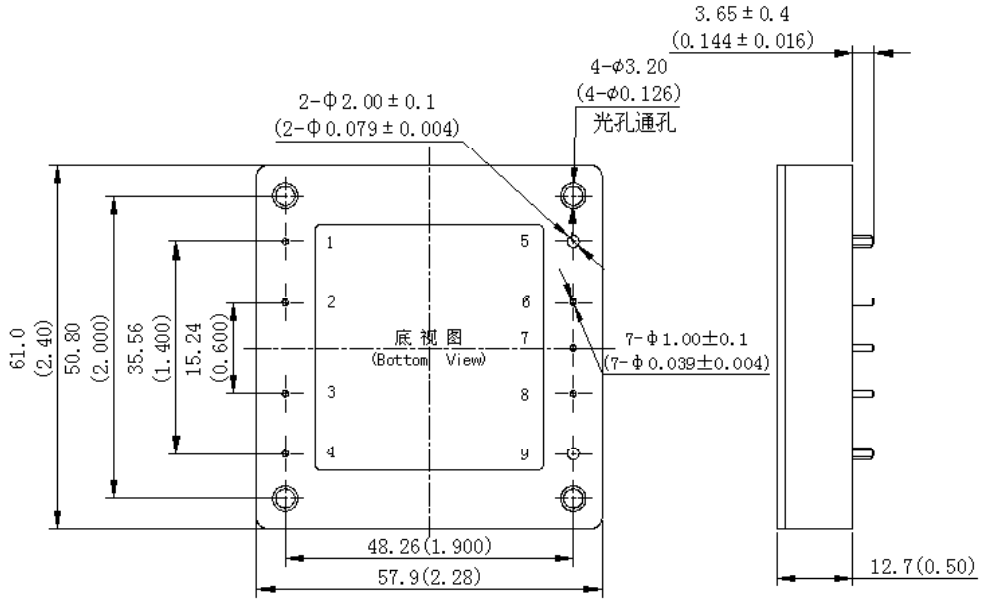
6 Outline Diagram and Pin Definition

6.1 Dimensions



(1) .X±0.5 (.XX±0.02) .XX±0.25 (.XXX±0.010)
(2) 单位：mm (inch)

6.2 Pin Definition

No.	1	2	3	4	5	6	7	8	9
Symbol	-Vin	FG	Rem	+Vin	-Vout	-S	Trim	+ S	+Vout
Definition	Negative Input	Grounding	Remote on/off	Positive Input	Negative Output	Negative Remote Sense	Trim	Positive Remote Sense	Positive Output

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